Influence of Prior Egg-laying Experience on Choice of Host Fruits for Oviposition by the Mediterranean Fruit Fly, *Ceratitis capitata* (Wiedemann)

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ABSTRACT

Laboratory populations of *Ceratitis capitata* were preexposed to either mock orange or sweet orange for oviposition. Compared with an unexposed population, both these populations showed a preference for their preexposure type host when offered a choice for 24 hours. By 48 hours all three populations oviposited exclusively on the sweet oranges. Subsequent removal of the preferred hosts resulted in the use of the alternative underexploited hosts.

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), is highly polyphagous, capable of using over 200 different hosts (Christenson and Foote 1960). For this reason the accidental introduction of this species into areas such as the U.S. mainland is considered an especially serious threat to agriculture. In Hawaii, certain hosts such as loquats, peaches and coffee are highly preferred; others, such as plums and persimmons are found infested only occasionally (Wong et al. 1983, Nishida et al. 1985).

The pattern of host uses is strongly influenced by seasonal abundance of the various hosts. Recent evidence indicates that the origin of the fly population and the previous oviposition experience of the flies influences the acceptance of a host fruit by ovipositing females (Prokopy et al. 1984, Cooley et al. 1986). The learning and forgetting of host acceptance occurs with both wild and laboratory populations of *C. capitata* (Papaj et al., In review).

The studies of fruit acceptance for oviposition by medflies have implicated a role of learning in the pattern of exploitation of hosts. All the behavior tests have been done with individual flies offered sequential opportunities to attempt oviposition into different hosts. To date no situations with groups of flies simultaneously exposed to alternate hosts have been studied. Such studies would seem to be a logical progression from the behavior studies already completed. It is hoped that this study will help to extend the findings from individual no-choice behavior tests toward what actually happens in fly populations in the field where simultaneously two or more host types may be available. In particular, these studies assess the impact of prior use of a particular host on the exploitation of hosts over several days in cages offering a choice of hosts.

MATERIALS AND METHODS

The laboratory strain of the USDA/ARS Tropical Fruit and Vegetable Research Laboratory in Honolulu was used. It was maintained at 25°C, 75% RH and 14L:10D photoperiod. When females were sexually mature and ready to oviposit, i.e. 4–5 days old, 20 females and 6 males were placed into each of nine colony

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(30 cm³) cages with sugar/protein hydrolysate food and water. The experiment lasted for 10 days, constituted of three periods, as follows:

Training period (96-h duration): At the onset (Day 0) 12 mock oranges *(Murraya paniculata)* were suspended from the top of cages 1–3. In cages 4–6 a single sweet orange *(Citrus sinensis)* was offered. In cages 7–9, no hosts were available. Fruits were replaced on Day 2, and on Day 4 all fruits were collected.

Testing period (48-h duration): On day 4, 12 suspended mock oranges were presented in each of the nine cages. On Day 5 all fruits were replaced. All test fruits were collected on Day 6.

Posttesting period (72-h duration): On Day 6 a sweet orange was offered in cages 1–3 and 12 suspended mock oranges in cages 4–9. Fruit was collected and replaced each day until the experiment was terminated on Day 9.

Throughout the experiment, fruits of a type were always of uniform ripeness, color and size when presented. Fruits were always collected and offered in the early morning before oviposition activity started. Fruits were dissected and eggs counted on the day following collection. Data were analyzed using the LSD test of Fisher (1935). Percentages were transformed to arcsin % before comparisons in order to normalize the data (Snedecor and Cochran 1967).

TABLE 1. Eggs collected in hosts after oviposition by trained or inexperienced *C. capitata* females.

	Eggs oviposited in mock orange (mo) or sweet orange (so)*		
Day/Host	Trained (mo)	Trained (so)	Inexperienced
Training			
2 (mo)	1051.0 ± 14.0a	-	-
(so)	-	556.7 ± 68.2b	-
4 (mo)	740.3 ± 108.5a	-	-
(so)	-	569.7 ± 7.4a	-
Testing			
5 (mo)	131.7 ± 11.7c	0.0 ± 0.0e	76.7 ± 13.4d
(so)	232.7 ± 28.7b	397.3 ± 48.1a	493.3 ± 92.0ab
6 (mo)	1.0 ± 1.0c	1.7 ± 0.9c	1.7 ± 1.7c
(so)	299.0 ± 99.6ab	249.7 ± 22.2a	128.0 ± 8.9b
Posttesting			
7 (mo)	-	106.2 ± 36.0b	250.3 ± 19.2a
(so)	227.3 ± 9.9a	-	-
8 (mo)	-	471.0 ± 57.0ab	507.7 ± 29.6a
(so)	387.7 ± 28.8b	-	-
9 (mo)	-	488.0 ± 23.7a	457.0 ± 15.3a
(so)	406.7 ± 34.9a	-	-

*(x + SE) Means followed by different letters for same day significantly different at p=0.05 by Fisher's (1935) LSD test. Entry of – indicates that fruit of that type was not offered on that day.

RESULTS AND DISCUSSION

There were significantly more eggs oviposited in mock orange than sweet orange early in the training period (Table 1). Since the clutch size should have been smaller in the mock oranges (McDonald and McInnis 1985), the number of training events for oviposition on mock oranges should have greatly exceeded the number on the sweet orange.

During the first 24 h of testing, flies conditioned on one of the hosts showed a significantly higher use of that (familiar) host than the flies which had not been given fruit prior to testing. Flies trained on mock orange oviposited an average (mean ± SE) 36.6 ± 4.5% of their total eggs in mock orange; those trained on sweet orange, 0% in mock orange, and those not trained, 14.5 ± 3.8% in mock orange. The percentage of oviposition in mock oranges was found to be significantly different ($p=0.05$) for each of the pretesting treatments (37.1 ± 2.7 vs. 0 vs. 21.9 ± 3.3 values after arcsin transformation, Fisher's LSD test). Despite the greater number of oviposition events for the population trained on mock orange, it was the population trained on sweet orange that completely rejected the alternative host.

On the second day of testing, all groups of flies oviposited exclusively on sweet orange. The sweet oranges provided much stronger training stimuli than did the mock oranges. If a history of using the sweet orange influenced a fly to land on that host, this as well as a learned behavior of host acceptance would have contributed to the exploitation of the sweet orange. The performance of flies from cages 7–9 which had not been exposed before testing indicates that the exclusive use of one of two type of initially acceptable fruit may develop in the presence of both.

During the posttesting period, flies in cages 1–3 sustained a high level of oviposition in the sweet orange. Flies in cages 4–6 showed a drop in oviposition level on the first posttraining day with the mock oranges, followed by an increased level on the second day. The drop could be attributed to the very strong effect of learning on the sweet orange. The subsequent rise could be attributed to forgetting. Flies in cages 7–9 initially showed a higher oviposition level on mock orange than those in cages 4–6, suggesting that their level of conditioning to sweet orange achieved during the testing was not as strong as that achieved by those conditioned during both training and testing periods.

These studies clearly show an effect of learning on the pattern of host use. They indicate that if the conditioning stimuli of one host type are strong, that host will be exploited much more than an equally acceptable type that provides weaker conditioning stimuli. These findings confirm the general belief shared by scientists involved with the control of medfly infestations, that the removal of a preferred host by fruit stripping can be expected to result in a shift to the use of alternative underexploited hosts. Therefore, all potential hosts should be removed when fruit stripping is carried out.

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